

The University of Chicago

SOME PHYSIOLOGICAL CHANGES DURING FRUSTRATION

A PART OF A DISSERTATION SUBMITTED TO
THE FACULTY OF THE DIVISION OF THE
BIOLOGICAL SCIENCES IN CANDIDACY FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

CHILD DEVELOPMENT

1940

By
E. HUDSON JOST

Private Edition, Distributed by
THE UNIVERSITY OF CHICAGO LIBRARIES
CHICAGO, ILLINOIS

Reprinted from
CHILD DEVELOPMENT, Vol. 12, No. 1, March 1941

The University of Chicago

SOME PHYSIOLOGICAL CHANGES DURING FRUSTRATION

A PART OF A DISSERTATION SUBMITTED TO
THE FACULTY OF THE DIVISION OF THE
BIOLOGICAL SCIENCES IN CANDIDACY FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

CHILD DEVELOPMENT

1940

By
E. HUDSON JOST

Private Edition, Distributed by
THE UNIVERSITY OF CHICAGO LIBRARIES
CHICAGO, ILLINOIS

Reprinted from
CHILD DEVELOPMENT, Vol. 12, No. 1, March 1941



SOME PHYSIOLOGICAL CHANGES DURING FRUSTRATION¹

HUDSON JOST

The purpose of this study was to determine what physiological changes occurred during experimental frustration and to correlate these changes with measures of the individual's adjustive pattern. The measures of physiological changes are most valuable because they give absolute and objective measures of emotional reactions.

The concept of the role of frustration in the determination of behavior, both normal and abnormal, has been accepted by most psychologists. It is generally assumed that frustration is accompanied by physiological tensions and that these tensions are essentially emotional in nature. In normal emotional behavior the tensions, which include visceral and skeletal activity, disappear within a relatively short time, that is, as soon as overt or covert activity re-establishes equilibrium. In situations of frustration, however, the tensions are more severe and prolonged because of the lack of solution of the frustrating problem.

The overt activity of an individual in one situation is determined by his past behavior in similar situations. Physiological activity, on the other hand, is not entirely dependent on past experience; thus it is relatively similar in different individuals. Because of this relative internal consistency, physiological processes are probably a better measure of the individual reactions to frustration than are the more variable overt responses. The tensions resulting from frustration lead to overt or covert activity, but the form of this activity is socially determined. In this respect the physiological tensions are motivators of activity but they do not determine the form of the behavior.

METHODS

The experiment consisted of seven parts. Physiological measurements were made in situations in the following sequence: (1) Rest, (2) Attention, (3) Learning, (4) Frustration, (5) Recall, (6) Rest, and (7) Sensory Stimulation. The rest periods, in which the subjects were instructed to relax, represented basal physiological levels. The attention, learning, recall, and sensory stimulation periods were introduced to obtain further control periods of physiological change. The physiological reactions during frustration were compared with the responses in the control periods.

The subjects were required to learn a sequence of digits by the anticipation method, that is, each number was guessed before it was flashed on a lighted panel. This apparatus consisted of a rectangular box faced with glass on which the digits 1 to 5 could be lighted by the experimenter. The subjects were allowed to learn successfully two series in order to give them feelings of success. Then a series of numbers apparently like the others but too difficult to recall was presented. Frustration occurred when a subject discovered that he could not learn a series which was very similar to the ones he had formerly learned easily.

¹The Orthogenic School, University of Chicago.

The subjects in the experimental group were eighteen children from the Orthogenic School; University of Chicago, representing a cross section of adjustable problems. Two were schizophrenic, five were diagnosed neurotics, and five were behavior problems. Except for the two psychotic children, each of the others had some signs of a neurotic condition. Twenty subjects which represented a control group, from the University Elementary School, were picked for the good adjustment they were making in school and play activities.

The data were analysed in the following three ways. The first consisted of a comparison of the reactions of the experimental and control groups, the second was a detailed analysis of the physiological responses of the experimental group. The third was a factorial analysis of the significant data, which will be published elsewhere with the presentation of further data.

MEASURES

The physiological measures used in this study were chosen because of their general relation to emotionality as indicated by previous work. The seven measures were: (1) Galvanic Skin Resistance, (2) Respiration, (3) Pulse Rate, (4) Blood Pressure, (5) Hand Tremor, (6) Gross Movements, and (7) Brain Potentials. All the measures except the brain potentials were recorded simultaneously with photographic methods. The type of photopolygraph has been described by Darrow.² The galvanic skin resistance was recorded through the use of a Behavior Research Resistance Box.³ The brain waves were recorded through the use of crystalline recording methods.⁴ The records of physiological changes were interpreted by methods similar to those used by Darrow and Heath, Wenger, Larsen, and Jasper.⁵

RESULTS

A total of fifty-two physiological measures were available for evaluation. These consisted of physiological changes during the entire experiment. Critical ratios were computed for each of these to discover which were diagnostic in the differentiation of emotionality. Seventeen measures had critical ratios above 2.00 and ten of these had critical ratios above 2.70. These measures are given in Table 1. A general survey of the differences between the experimental (emotionally unstable) and the control (emotionally stable) groups indicated that the physiological changes occurring during the various experimental conditions, and especially during frustration, were exaggerated in the experimental group.

²C. W. Darrow, *The behavior research photopolygraph*, *J. General Psychol.*, 1932, 7, 215-219.

³C. W. Darrow, *Uniform current for continuous standard unit resistance records*, *J. General Psychol.*, 1932, 6, 471-479.

⁴K. Jensen, *Electrical activity of the nervous system: I Apparatus*, *J. Exper. Educ.*, 1938, 6, 233-287. F. Offner and R. W. Gerard, *A piezoelectric crystal actuated ink writer*, *Science*, 1936, 84, 209.

⁵C. W. Darrow and L. L. Feath, *Reaction tendencies to personality: in Studies on the Dynamics of Behavior*, edited by K. S. Lashley, University of Chicago Press, 1932. M. A. Wenger, *Some relationships between muscular processes and personality and their factorial analysis*; *Child Development*, 1938, 9, 261-276. J. A. Larsen, *Lying and its detection*; University of Chicago Press, 1932. R. H. Jasper et al., *The electroencephalographic analysis of behavior problem children*. *Am. J. Psychiat.*, 1938, 95, 641-658.

JOST: CHANGES DURING FRUSTRATION

TABLE 1

PHYSIOLOGICAL MEASURES AND THEIR CRITICAL RATIOS

Measure	Average		Sigma		CR
	Cont.*	Exper.**	Cont.*	Exper.**	
I. Rest					
1. Sigma of Respiration	1.53	2.53	.55	1.42	2.86
2. Hand tremor	1.14	3.14	.98	2.40	3.34
3. Initial Resistance (Ohms)	7,150	12,000	2,460	7,000	3.06
4. Leg Movement	.12	.43	.19	.53	2.46
5. Number of Respirations	9.30	10.80	2.25	2.46	2.00
II. Attention					
6. Equation of Galvanic response	45.5	8.9	20.	16.	6.00
7. % Change Resistance	-15.0	-25.2	10.9	13.4	2.60
8. % Change of Pulse rate	.95	3.70	6.0	3.2	2.30
III. Learning					
9. % Change in Galv. resistance	6.7	-17.2	17.	24.2	3.52
IV. Frustration					
10. % Change in Galv. resistance	-3.7	-22.2	13.6	15.6	3.70
11. % Change in pulse rate	3.5	7.4	4.7	4.8	2.44
V. Rest					
12. Hand tremor	.93	2.86	1.18	2.37	5.45
13. % Change in Pulse rate	-3.8	0	3.26	4.23	3.10
VI. Stimulation					
14. Equation of Galv. response	46.	18.	10.	11.	8.10
15. Blood Pressure Change	3.6	5.0	1.38	2.02	3.90
16. % Change Galv. Resistance	-24.1	-35.8	13.8	18.5	2.16
17. EEG (% of alpha dominance)	85.2	62.1	11.2	15.4	2.90

*Control Group

**Experimental Group

This greater response pattern may be due to a greater sensitivity to stimulation or may be accounted for as an inability to control these autonomic activities once they are initiated by a stimulating situation.

Group Differences: (1). Galvanic Skin Resistance. The initial skin resistance of the control group was 7,150 ohms and that of the experimental group was 12,000 ohms. The critical ratio between these measures was 3.06. This difference may be due to the general reactivity of the two groups. The members of the control group were physiologically in a condition which made reactivity possible with the least disturbance of autonomic functions, whereas the members of the experimental group were in a sense "frozen" and when stimulated reacted more violently. This is shown by the fact that the resistance of the control group varied only slightly during the different experimental situations while that of the experimental group varied greatly.

During the first rest period there was no significant difference between the two groups in the per cent rise in galvanic skin resistance. There was a significant difference when the subject's attention was called to the learning process. The members of the experimental group were more disturbed by the process of attention as indicated by a drop of 25.3 per cent in resistance than were those of the control group who showed a 15.0 per cent drop in resistance. The critical ratio of this measure was 2.60. The control group made an adjustment to the learning process as indicated by a 6.7 per cent rise in the resistance level. The experimental group, however, showed a drop of 17.2 per cent which indicated that an adjustment was not made and that tension continued throughout the period. The critical ratio of the measure was 3.52.

During the frustration period the control group showed a drop in resistance level of 3.7 per cent which may indicate feelings of concern about the failure. The experimental group during the same period of time showed a drop in resistance of 22.2 per cent. The critical ratio of this measure was 3.70. These changes indicate that the same physiological processes were at work in the two groups but that the members of the experimental group were more disturbed than were those of the control group.

Another measure of the galvanic skin resistance which proved to be significant in differentiating between the two groups was that of the equation of the galvanic skin response. During the period of attention the equation of the galvanic response for the control group was 45.5, whereas that of the experimental group was 8.9. The critical ratio was 6.00. The response during sensory stimulation for the control group had an equation of 46.0 and for the experimental group 18.1. The critical ratio was 8.10. This measure indicated that the members of the control group were better able to reorient themselves to the total situation than were the members of the experimental group.

(2). Heart Rate. The initial heart rate of the two groups was the same but during the experimental procedures there was a slightly greater speeding of the rate in the experimental than in the control group. This difference was not significant for the first stimulating conditions. The heart rate in the last rest period showed a reliable difference between the groups. The control group returned to a slower rate than was maintained before frustration, whereas the experimental group returned only to the former level. The critical ratio of this measure was 3.10. This

indicated, as did the equations of galvanic responses, a faster and more complete return to the prestimulus level of physiological activity for the members of the control group.

(3). Blood Pressure. The blood pressure changes were not significantly different in the two groups except during sensory stimulation. The blood pressure of the experimental group rose sharply during sensory stimulation, and was indicated by an average displacement of 5.0 mm. on the recording paper. The change for the control group was only 3.6 mm. The critical ratio was 3.90. This is another example of the exaggerated reaction of the experimental group.

(4). Tremor Movements. The measures of hand movements indicated that the experimental group was more tense than the control group. The tremor movements before and after stimulation of the control group were 1.14 and .93 per half minute respectively. In the experimental group the tremor movements in the same periods were 3.14 and 2.85 movements per half minute. The critical ratios for these measures were 3.34 and 5.45 respectively. The gross movements were not significantly different in the two groups.

(5). Respiration. The irregularity of the respiratory movements as measured by the standard deviation of their individual amplitudes showed a marked difference in the two groups. The sigma of the amplitudes of the control group was 1.53 mm., whereas that of the experimental group was 2.54 mm. The critical ratio of this measure was 2.86. The control group had an average of 9.3 respiratory movements per half minute and the experimental group had an average of 10.8 movements per half minute. The critical ratio of this measure was 2.00. A study of the complete respiratory cycle indicated that the more regular and slower respiratory movements were manifested by the normal group of children.

(6). Electroencephalogram. The alpha rhythm was dominant 85 per cent of the total time in the control group and 62.1 per cent in the experimental group. The critical ratio of this measure was 2.90. It has been pointed out in other studies of brain potentials that the alpha rhythm is suppressed during sensory stimulation. Since stimulation of the exteroceptors will suppress these waves it is probable that stimulation from the interoceptors (and of the autonomic nervous system) may also have the same effect. If this is the case there would be a suppression of the rhythm in individuals who are more or less continually emotionally disturbed. In this study it was found that there was a greater suppression of the alpha rhythm in the more disturbed individuals.

Individual Differences: The seventeen physiological measures which were shown to be significant in differentiating the control and experimental groups were then applied to the members of the experimental group. The subjects in the experimental group were observed over a long period, and extensive information was available. The following data other than the physiological measures were available; mental age, intelligence quotient, social maturity age, the scores on the Vineland scale of emotional stability, and ratings of emotional stability by trained observers.

The following physiological measures correlated most highly with emotionality: (1) per cent change of galvanic skin resistance during frustration, .79. (2) Dominance of the alpha rhythm in the electroencephalogram, .73. (3) Sigma of respiratory amplitudes, .60. (4) Initial

galvanic skin resistance, .56. (5) Pulse rate change at attention, .56. (6) Hand tremor before frustration, .56.

A better picture of an individual's physiological instability was obtained when all of the measures were considered. It was arbitrarily assumed that a subject was unstable when more than half of his measures were outside of one sigma of the mean of the control group. This assumption fitted very well the cases in this study. Six of the eighteen subjects in the experimental group showed patterns of physiological activity which fitted into the stable group. Four of these were well adjusted in the socially accepted manner. Two subjects of the experimental group were schizophrenic, and responded physiologically like the normal subjects. This indicated that well adjusted and psychotic individuals present the same stable physiological pattern. The remaining twelve subjects showed varying degrees of physiological instability which correlated highly (.79) with their emotional adjustment as judged by trained observers.

Further results of individual differences as well as the factor analysis will appear in another paper which is in the process of publication.

SUMMARY

A total of fifty-two physiological measures were taken during several experimental situations in eighteen emotionally unstable and twenty very stable children. The physiological measures were of respiration, galvanic skin resistance, pulse rate, muscle tension, and brain waves. The various experimental situations consisted of rest, attention, learning, frustration, recall, and sensory stimulation.

Ten measures had critical ratios above 2.70 which ruled out chance factors in their differentiation of the two groups. These measures were correlated with the reaction patterns of the members in the experimental group. The variance of the scores of this group from the mean scores of the control group gave a good indication of the individual's instability.

The results warrant the following tentative conclusions:

1. The following ten measures were most significant in the differentiation between the stable and unstable groups: (1) Initial galvanic skin resistance, (2) Per cent change of level of resistance during learning, (3) Per cent change of resistance during frustration, (4) Equation of galvanic responses at attention and sensory stimulation, (5) Hand tremor before frustration, (6) Hand tremor after frustration, (7) Blood pressure change at sensory stimulation, (8) Dominance of the alpha rhythm in electroencephalogram, (9) Standard deviation of the amplitudes of respiratory movements, and (10) Change in heart rate after frustration.

2. The experimental group showed an exaggerated physiological reaction pattern as well as a slower return to the prestimulus level of physiological activity.

3. The variance of the measures of the unadjusted individuals from the mean measures of the adjusted group gave a good indication of the degree of emotional disturbance. These measures correlated .79 with the ratings of these children regarding their emotional reactivity.

4. The psychotic and well adjusted individuals presented the most

stable physiological patterns; whereas the pre-psychotic and neurotic individuals presented the most unstable patterns.

5. Unstable individuals reacted more violently to a frustration situation than did the stable individuals as measured by their physiological reactions. The unstable individuals also showed more variable patterns of physiological activity during the control periods than did the stable individuals.

6. The physiological tensions resulting from frustration are motivational but not directive in action. They are less variable from individual to individual and are thus probably a better measure of the reaction to frustration than are the more variable overt reactions.

